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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/593,444	02/05/2007	Makiko Kitazoe	029567-00011	8995

4372 7590 08/24/2010

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EXAMINER	
MILLER, JR, JOSEPH ALBERT	
ART UNIT	PAPER NUMBER
1715	

NOTIFICATION DATE	DELIVERY MODE
08/24/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/593,444	KITAZOE ET AL.	
	Examiner	Art Unit	
	JOSEPH MILLER JR	1715	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *02 August 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-19* is/are pending in the application.

4a) Of the above claim(s) *1-7* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *8-19* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 8-19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamoto (2002/0104477) in view of Wang (2004/0121085), Nguyen (6,689,220) as evidenced by Raaijmakers (2002/0052124).

Yamoto teaches the formation of a silicon nitride film using silane, ammonia, and hydrogen gases flowed to a substrate, after being activated by a catalyst [0148]. Yamoto teaches a hydrogen gas treatment step after film formation (the silane and ammonia are turned off and it is clear that the hydrogen is still flowing), the purpose of the hydrogen flow is to purge the other reactants [0149] but the selection of hydrogen is linked to performance of the catalyst body [0021].

Yamoto does not (explicitly) teach the formation of a multi-cycle film for the formation of a multi-layer film of a single type (i.e. a multi-layered SiN film) wherein the second treatment is not a subsequent deposition step.

Wang teaches a method of forming a silicon nitride film (abstract). Wang teaches the deposition of silicon nitride using chlorine-containing gases and ammonia [0025-0026]. Wang teaches that the films may be treated with a nitrogen source gas after deposition [0028] followed by exposure to hydrogen radicals (including the use of

hydrogen gas) after the nitrogen exposure step [0033], the hydrogen radicals being formed by a hot wire process and used when a chlorinated and/or organo silicon precursor is used [0030]. Wang teaches that the hydrogen radicals can penetrate less than 100 angstroms deep into the film [0035] and therefore if a thicker film is required, multiple layers should be deposited in order to achieve a desired thickness.

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the post-SiN film formation treatments of Wang (nitrogen followed by hydrogen) to the hot wire SiN film formation technique of Yamoto because the nitrogen step would increase the N/Si ratio and reduce hydrogen [0028] and the hydrogen treatment step would remove chlorine from the film [0029-0032].

The nitrogen then hydrogen treatment steps of Wang would follow the hydrogen purge of Yamoto. Because the hydrogen purge of Yamoto includes maintaining the temperature of the catalyst, the hydrogen would be available as an active species.

It would be obvious to repeat the steps, as taught by Wang, so that a complete SiN could be formed with effective removal of the chlorine. Wang teaches that a 200A thick silicon nitride film is useful for 65 nm technology [0037].

Yamamoto in view of Wang teaches all aspects of the instant claims except the step of providing and a step of opening a first valve and closing a second valve.

Nguyen teaches a method of depositing a highly controlled layered film (abstract). Nguyen teaches the use of a system and method including the use of a gas supply line which includes an additional line and valve to go to vent and a second line and valve to go to the process chamber (col 7, lines 13-21; Fig. 3). Nguyen further

teaches flowing gas into the vent prior to flowing to the chamber (i.e. opening the valve to the vent, closing that to the vessel and then switching the valves).

It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the pulsation method of Nguyen involving flowing gas to vent to the method of Yamamoto in view of Wang as it would allow for a pulsation technique without requiring stabilization time (col 7, lines 18-22). While Nguyen does not explicitly teach the inclusion of an MFC, the prior art references teach control of flow rate: Yamamoto [0074, for example] and Wang [0026] teach the control of a flow rate (in sccm, versus pressure, for example) - Raaijmakers provides evidence that the use of MFCs to control the flow rate of gases is known [0051].

Examiner holds that the teaching of Nguyen sufficiently discloses a "rectangular pulsed flow" as required in instant claims.

Regarding claims 8 and 9, it would be obvious to repeat the treatment steps to effect a usable film. The repetition of treatments and anneals is well known in the deposition art. In instant case, because the hydrogen treatment step would potentially leave more hydrogen than is desired in the film, it would be obvious to re-treat with a nitrogen treatment.

Regarding claim 10, Wang teaches continuous formation of the film including treatment steps for a number of layers [0037].

Regarding claim 11, Yamoto teaches the discharge of the gases from the process chamber [00149] taught by Yamoto is a vacuum pump [0065].

Regarding claim 12, the nitrogen step adds nitrogen to the film and the hydrogen step depletes chlorine (or carbon) from the film.

Regarding claim 13, Wang teaches that the hydrogen treatment may include nitrogen gas and therefore the final step includes a film component.

Regarding claim 14, Wang teaches the use of ammonia instead of hydrogen (i.e. reading on 'rare gas' required in claim) and nitrogen, helium or argon.

Regarding claim 15, Yamoto teaches deposition using silane and ammonia. Wang teaches the use of hexachlorodisilane (HCD) as a silane source gas [0025]. It would have been obvious to someone of ordinary skill in the art at the time of the invention to apply the use of HCD instead of silane as a viable alternative and to allow for improved step coverage of the resulting film [Wang, 0024].

Regarding claim 16, Wang teaches the use of ammonia (hydride of nitrogen) as a surface treatment gas.

Regarding claim 17, all limitations are taught as per Yamoto in view of Wang as described above regarding claims 8 and 14.

Regarding claim 18, the process as taught by Wang is with an ammonia treatment after the nitrogen treatment.

Regarding claim 19, the teaching of Nguyen is generic to gas flow control and examiner takes the position that the control method taught to avoid a stabilization time period would be obvious to apply to any and all of the gases in a pulsed process.

Response to Arguments

Applicant's arguments in regards to the 112 rejection concerning the term "rectangular pulse" are accepted and the rejection is withdrawn.

Applicant's arguments filed 08/02/2010 have been fully considered but they are not persuasive in regards to the rejections over the prior art. Applicants argue that the combined prior art does not teach *simultaneously* opening and closing valves (Nguyen in particular was relied on for this feature). Examiner does not agree. The text of Nguyen states that the valves are "switched" (col 7, lines 13-21). Such a statement could imply the "switching" (shutting or opening) of the individual valves (i.e. 34 and 35) and could also be reasonably interpreted to mean that the valves are 'switched' in the sense that one is open(ed) while the other is close(d). There is no suggestion in Nguyen that would prohibit this (broader) interpretation of 'switching'.

Nguyen requires a pulsation which could be effectively managed by a non- or simultaneously opening and closing of the valves, however, as noted in the action, Nguyen desires a stable flow and also specifically teaches "fast switching". If the valves were not opened/closed simultaneously, there would be a surge (or deficit) of flow going into the chamber – this would not in fact optimally allow the flow to be stable relative to the chamber and would not meet Nguyen's requirements.

Furthermore, if the valves are not each switched simultaneously, there would be an overlap of flow through both valves 34 and 35 - this would contradict a "fast switching" (at least in the context of the fastest possible switching).

Examiner therefore takes the position that though not the word "simultaneous" is not explicitly stated by Nguyen, the context of the teachings suggest that the two valves would be "switched" as in the meaning of "simultaneously changed" to meet the requirements of a stable flow and fast switching.

Further, the suggestion by Nguyen of simultaneously closing one valve and opening another meets applicant requirements for a "rectangular pulsed flow" (synonymous with applicant arguments over the previous 112 rejection).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOSEPH MILLER JR whose telephone number is (571)270-5825. The examiner can normally be reached on Mon-Thurs, 7am-4pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/JOSEPH MILLER JR/
Examiner, Art Unit 1715

/Timothy H Meeks/
Supervisory Patent Examiner, Art Unit 1715